

REMARKS

In the last Office Action, the Examiner rejected claims 14-16, 21 and 29 under 35 U.S.C. §112, first paragraph, as containing subject matter which was not described in the specification in such a way so as to reasonable convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Claim 14 was rejected under 35 U.S.C. §112, second paragraph, for indefiniteness. Claim 14 was rejected under 35 U.S.C. §102(a) as being anticipated by U.S. Patent No. 6,175,181 to Shirazaki, U.S. Patent No. 5,917,268 to Takagi, U.S. Patent No. 5,783,899 to Okazaki, or U.S. Patent No. 5,477,100 to Kataoka. Claim 16 was rejected under 35 U.S.C. §102(a) as being anticipated by Takagi, Japanese Patent No. 2-202382, or Japanese Patent No. 8-126359. Claim 17 was rejected under 35 U.S.C. §102(a) as being anticipated by U.S. Patent No. 4,959,579 to Kuwabara et al. ("Kuwabara") or U.S. Patent No. 5,091,670 to Kawata et al. ("Kuwata"). Claim 37 was rejected under 35 U.S.C. §102(a) as being anticipated by U.S. Patent No. 6,242,846 to Ashizawa et al. ("Ashizawa"). Claims 1-3, 6-9, 11, 12, 18-20, 22-27, 30-36, 38, 39 and 41-43 were allowed by the Examiner.

Applicants and applicants' counsel note with appreciation the indication of allowable subject matter concerning claims 1-3, 6-9, 11, 12, 18-20, 22-27, 30-36, 38,

39 and 41-43. However, for the reasons noted below, applicants respectfully submit that claims 14-17, 21, 29 and 37 also patentably distinguish from the prior art of record.

In accordance with the present response, the specification has been suitably revised to provide antecedent basis for the term "separated" recited in the claims. Independent claim 14 has been amended to overcome the rejection under 35 U.S.C. §112, second paragraph, and to further patentably distinguish from the prior art of record. Claims 15 and 16 have been amended to change "divided" to "separated" to conform to the revision in the specification. Claim 17 has been amended to clarify that the rotational movement of the moving body is "restricted" by the pressurizing member and the bearing portion.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached pages i-iv are captioned "**VERSION WITH MARKINGS TO SHOW CHANGES MADE**".

Applicants respectfully request reconsideration of their application in light of the following discussion.

Rejection Under 35 U.S.C. §112, First Paragraph

The Examiner rejected claims 14-16, 21 and 29 under 35 U.S.C. §112, first paragraph. Relying on the "written description" requirement of 35 U.S.C. §112, first paragraph, the Examiner contends that claims 14-16, 21 and 29 contain

subject matter (i.e., the direction of polarization of the piezoelectric element) which was not described in the specification in such a way so as to reasonable convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Applicants respectfully traverse this contention.

The purpose of the written description requirement of 35 U.S.C. §112, first paragraph, is to ensure that the inventor had possession of the invention as of the filing date. In re Wertheim, 191 USPQ 90, 96 (CCPA 1976). In deciding whether or not the written description requirement has been satisfied, the content of the drawings may be considered. In re Kaslow, 217 USPQ 1089, 1096 (Fed. Cir. 1983).

In the instant case, the originally filed specification, drawings and claims clearly describe the polarization direction of the piezoelectric element (i.e., see specification pages 8-10, Figs. 3-4, and originally filed claim 14). For example, in the embodiment shown in Fig. 3, the piezoelectric element 2 has a surface divided or separated into four areas (i.e., four areas which are separated by two lines connecting a center of the piezoelectric element) and each of four electrodes 3b-3e is disposed on a respective one of the areas. The areas of the piezoelectric element on which the electrodes 3b-3e are formed are polarized in the same

direction, with "+" referring to the polarization direction (specification, pg. 8, line 19 to pg. 9, line 2). Thus the disclosure of the polarization direction of the piezoelectric element in the specification, drawings and claim 14 as originally filed would reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the invention claimed in claims 14-16, 21 and 29.

In view of the foregoing, applicants respectfully submit that claims 14-16, 21 and 29 are in full compliance with the "written description" requirement of 35 U.S.C. §112, first paragraph, and request that the rejection of claims 14-16, 21 and 29 under 35 U.S.C. §112, first paragraph, be withdrawn.

Rejection Under 35 U.S.C. §112, Second Paragraph

The Examiner rejected claim 14 under 35 U.S.C. §112, second paragraph, for indefiniteness. The Examiner contends that the term "divided" in the recitation "the piezoelectric element has a plurality of divided areas" is unclear. Applicants respectfully traverse this contention.

Applicants respectfully submit that claim 14 is in full compliance with the requirements of 35 U.S.C. §112, second paragraph, which, in relevant part, provides:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter

which the applicant regards as his invention.

The "distinctly claiming" requirement of 35 U.S.C. §112, second paragraph means that the claims must have a clear and definite meaning when construed in light of the complete patent document. Miles Laboratories, Inc. v. Shandon, Inc., 27 USPQ2d 1123, 1126 (Fed. Cir. 1993).

In the specification (pages 8-10), applicants describe embodiments of the ultrasonic motor having a piezoelectric element according to the present invention. In the embodiment shown in Fig. 3, for example, the piezoelectric element 2 has a surface divided or separated into four areas (i.e., four areas which are divided or separated by two lines connecting a center of the piezoelectric element) and each of four electrodes 3b-3e is disposed on a respective one of the areas. In the embodiment shown in Fig. 4, the four areas of the piezoelectric element are divided or separated by two diagonal lines passing through the center of the piezoelectric element 2. Thus the term "divided" as described in the specification and shown in the drawings refers to a separation of the areas of the piezoelectric element by boundaries which in the instant case constitute the connecting lines shown in Figs. 3 and 4.

In view of the foregoing, applicants respectfully submit that the language of claim 14 particularly points out and distinctly claims the subject matter which applicants

regard as their invention, as required by 35 U.S.C. §112, second paragraph. When read in light of the complete patent document, as directed by the Court of Appeals for the Federal Circuit, the language of claim 14 is without any ambiguity.

Nevertheless, in order to expedite prosecution, independent claim 14 has been amended to recite that the piezoelectric element has "a plurality of areas". Claim 15 has been amended to recite that the piezoelectric element has four areas "separated" by two diagonal lines of the vibrating body. Likewise, claim 16 has been amended to recite that the piezoelectric element has four areas "separated" by two lines connecting a center of two sides of the vibrating body.

In view of the foregoing, applicants respectfully submit that the rejection of claim 14 under 35 U.S.C. §112, second paragraph, has been overcome and should be withdrawn.

Brief Summary of the Invention

The present invention is directed to an ultrasonic motor and to an electronic apparatus equipped with the ultrasonic motor.

As described in the specification (pgs. 1-3), the thickness of the vibrating body of conventional ultrasonic motors must be increased in order to obtain displacement of the moving body in a feed direction. The increase in

thickness of the vibrating body increases the resonant frequency which adversely affects the driving efficiency and stability of the ultrasonic motor.

The present invention overcomes the drawbacks of the conventional art. Fig. 3 shows an embodiment of an ultrasonic motor according to the present invention embodied in the claims. The ultrasonic motor has a vibrating body 1 and a piezoelectric element 2 disposed on the vibrating body 1 for generating a vibration wave to vibrate the vibrating body. The vibration wave generated by the piezoelectric element 2 has a vibration node disposed on a diagonal line 10a of the vibrating body 1. The piezoelectric element 2 has four areas divided by two lines each connecting centers of a first pair of opposite sides and centers of a second pair of opposite sides, respectively, of the vibrating body 1. Electrode portions 3b-3e are disposed on respective ones of the four areas of the piezoelectric element 2. The areas of the piezoelectric element 2 on which the electrode portions 3b-3e are formed are polarized in the same direction after the piezoelectric element 2 is formed on the vibrating body 1 (e.g., in Fig. 3 "+" refer to the polarization direction). At least one protrusion 1a is connected to the vibrating body 1 for vibration therewith. The protrusion 1a is disposed on the vibrating body 1 at a position which does not correspond to the position of the vibration node of the vibration wave.

A moving body 8 is disposed in contact with and is driven (i.e., rotates in the directions denoted by arrows 12, 13 in Fig. 2) by the protrusion 1a during vibration thereof.

In another embodiment, as shown in Fig. 2, the piezoelectric element 2 has four areas each having an electrode portion and divided by two diagonal lines 10a, 10b of the vibrating body 1. The vibration wave generated by the piezoelectric element 2 has a vibration node disposed on a line connecting a center of a first side of the vibrating body 1 and a center of a second side of the vibrating body 1 opposite to the first side.

Preferably, in the foregoing embodiments according to the present invention embodied in the claims, the vibrating body 1 is generally quadrilateral-shaped. The electrode portions of the piezoelectric element 2 generate a bending vibration wave in a thickness direction of the vibrating body 1.

By the foregoing construction, an ultrasonic motor having improved driving efficiency and stability is provided as compared to the conventional art. For example, the output characteristic of the ultrasonic motor according to the present invention is constant regardless of the thickness of the vibrating body and the direction of rotation of the moving body. Furthermore, the resonant frequency of the ultrasonic motor of the present invention is decreased, thereby obtaining

an increase in amplitude. Additionally, by providing a vibrating body which is generally quadrilateral-shaped, mass-production of the vibrating bodies is facilitated.

Traversal of Prior Art Rejections

Claim 14 was rejected under 35 U.S.C. §102(a) as being anticipated by Shirazaki, Kataoka, Takagi or Okazaki. Applicants respectfully traverse this rejection and submit that amended claim 14 recites subject matter which is not identically disclosed or described in Shirazaki, Kataoka, Takagi and Okazaki.

Amended independent claim 14 is directed to an ultrasonic motor and requires a vibrating body, a piezoelectric element having a plurality of areas and formed on the vibrating body, and a plurality of electrodes each formed on a respective one of the areas of the piezoelectric element. Amended claim 14 further requires that the areas of the piezoelectric element on which the electrodes are formed are polarized in the same direction after the piezoelectric element is formed on the vibrating body. No corresponding structural combination is disclosed or described by Shirazaki, Kataoka, Takagi and Okazaki.

Each of Shirazaki, Kataoka, Takagi and Okazaki discloses a vibration driven motor having a vibrating body, a piezoelectric element disposed on the vibrating body, and

electrodes formed on the piezoelectric element. However, none of the references disclose or describe that areas of the piezoelectric element on which the electrodes are formed are polarized in the same direction after the piezoelectric element is formed on the vibrating body, as required by amended independent claim 14. In the absence of the foregoing disclosure recited in amended independent claim 14, anticipation cannot be found. See, e.g., W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) ("Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration"); Continental Can Co. USA v. Monsanto Co., 20 USPQ2d 1746, 1748 (Fed. Cir. 1991) ("When more than one reference is required to establish unpatentability of the claimed invention anticipation under § 102 can not be found."); Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added) ("Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim").

Stated otherwise, there must be no difference between the claimed invention and the reference disclosures, as viewed by a person of ordinary skill in the field of the invention. This standard is clearly not satisfied by Shirazaki, Kataoka, Takagi and Okazakis for the reasons stated

above. Furthermore, Shirazaki, Kataoka, Takagi and Okazaki do not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify the vibration driven motors of Shirazaki, Kataoka, Takagi and Okazaki to arrive at the claimed invention.

In view of the foregoing, applicants respectfully request that the rejection of claim 14 under 35 U.S.C. §102(a) as being anticipated by Shirazaki, Kataoka, Takagi or Okazaki be withdrawn.

Claim 16 was rejected under 35 U.S.C. §102(a) as being anticipated by Takagi, Japan '382 or Japan '359. Applicants respectfully traverse this rejection and submit that claim 16 recites subject matter which is not identically disclosed or described in Takagi, Japan '382 or Japan '359.

Amended independent claim 16 is also directed to an ultrasonic motor and requires a generally plate-shaped body and a piezoelectric element bonded on the vibrating body and having four areas separated by two lines connecting a center of a first side of the vibrating body and a center of a second side of the vibrating body opposite to the first side. Claim 16 further requires that each area has an electrode portion, that the piezoelectric element has a plurality of polarized portions polarized in the same direction and each corresponding to a respective one of the electrode portions, and that the vibrating body is vibrated by applying drive

signals different in phase by 180 degrees to two of the electrode portions.

Applicants respectfully submit that Takagi, Japan '382 and Japan '359 do not disclose or describe the structural combination of the ultrasonic motor recited in amended independent claim 16.

Takagi discloses a vibration driven motor having an elastic member and an electro-mechanical converting element connected to the elastic member. Each of Japan '382 and Japan '359 discloses a vibration driven motor having piezoelectric bodies. However, neither Takagi, Japan '382 nor Japan '359 discloses or describes the structure and corresponding function of the ultrasonic motor recited in independent claim 16. More specifically, the references do not disclose or describe an ultrasonic motor comprised of a piezoelectric element having a plurality of polarized portions polarized in the same direction, as required by independent claim 16. Since Takagi, Japan '382 and Japan '359 do not disclose or describe a piezoelectric element having a plurality of polarized portions polarized in the same direction, as recited in independent claim 16, there can be no anticipation by Takagi, Japan '382 and Japan '359 of independent claim 16 under 35 U.S.C. §102(a). That is, since each and every limitation of independent claim 16 is not found in Takagi, Japan '382 and Japan '359, the references do not anticipate

the claimed invention. See In re Lange, 209 USPQ 288, 293 (CCPA 1981). Furthermore, Takagi, Japan '382 and Japan '359 do not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify the vibration driven motors of Takagi, Japan '382 and Japan '359 to arrive at the claimed invention.

In view of the foregoing, applicants respectfully request that the rejection of claim 16 under 35 U.S.C. §102(a) as being anticipated by Takagi, Japan '382 or Japan '359 be withdrawn.

Claim 17 was rejected under 35 U.S.C. §102(a) as being anticipated by Kuwabara or Kawata. Applicants respectfully traverse this rejection and submit that claim 17 recites subject matter which is not identically disclosed or described in Kuwabara or Kawata.

Amended independent claim 17 is directed to an ultrasonic motor and requires a vibrating body having a piezoelectric element for vibrating the vibrating body, a moving body rotationally driven by a vibration of the vibrating body, a pressurizing member for pressing the moving body into pressure contact with the vibrating body, and a bearing portion disposed on the pressurizing member for guiding rotational movement of the moving body. Claim 17 further requires that rotational movement of the moving body is restricted by the pressurizing member and the bearing portion.

Kawabara and Kawata are directed to ultrasonic motors having a stator, a rotor, a moving body, and a pressurizing member. However, neither Kawabara nor Kawata discloses or describes a bearing portion for guiding rotational movement of the moving body, as required by independent claim 17. Likewise, the references do not disclose or describe a pressurizing member and a bearing portion for restricting rotational movement of the moving body, as required by amended independent claim 17.

Accordingly, since the foregoing limitations of independent claim 17 are not found in Kawabara or Kawata, the references do not anticipate the claimed invention. See In re Lange, 209 USPQ 288, 293 (CCPA 1981). Furthermore, Kawabara and Kawata do not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify the ultrasonic motors of Kawabara and Kawata to arrive at the claimed invention.

Should the Examiner maintain the rejection of claim 17 on the basis of Kawabara or Kawata, applicants respectfully request that the Examiner specifically point out the teachings in such references corresponding to the bearing portion for guiding the rotational movement of the moving body and corresponding to the structural combination of a pressurizing member and a bearing portion for restricting rotational movement of the moving body as recited in independent claim 17.

In view of the foregoing, applicants respectfully request that the rejection of claim 17 under 35 U.S.C. §102(a) as being anticipated by Kawabara or Kawata be withdrawn.

Claim 37 was rejected under 35 U.S.C. §102(a) as being anticipated by Ashizawa. Applicants respectfully traverse this rejection and submit that claim 37 recites subject matter which is not identically disclosed or described in Ashizawa.

Independent claim 37 is directed to an ultrasonic motor and requires a vibrating body, a piezoelectric element disposed on the vibrating body for generating a vibration wave to vibrate the vibrating body, the vibration wave having a vibration node disposed on a line connecting a center of a first side of the vibrating body and a center of a second side of the vibrating body opposite to the first side, at least one protrusion connected to the vibrating body for vibration therewith, the protrusion being disposed on the vibrating body at a position which does not correspond to the position of the vibration node, a moving body disposed in contact with and driven by the protrusion during vibration thereof, and a support member for supporting the vibrating body along a line connecting a center of a first side of the vibrating body and a center of a second side of the vibrating body opposite to the first side.

Thus independent claim 37 requires an ultrasonic motor having a support member for supporting the vibrating body along a line connecting a center of a first side of the vibrating body and a center of a second side of the vibrating body opposite to the first side. In contrast, while Ashizawa discloses an ultrasonic actuator having a shaft supporting a center of a vibrating body, the shaft does not support the vibrating body along a line connecting a center of a first side of the vibrating body and a center of a second side of the vibrating body opposite to the first side, as required by independent claim 37. Since Ashizawa does not disclose or describe this feature recited in independent claim 37, there can be no anticipation by Ashizawa of independent claim 37 under 35 U.S.C. §102(a). That is, since each and every limitation of independent claim 37 is not found in Ashizawa, the reference does not anticipate the claimed invention. See In re Lange, 209 USPQ 288, 293 (CCPA 1981). Furthermore, Ashizawa does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify the vibration actuator of Ashizawa to arrive at the claimed invention.

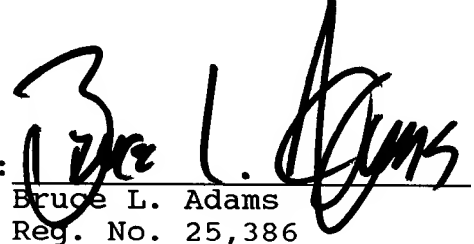
In view of the foregoing, applicants respectfully request that the rejection of claim 37 under 35 U.S.C. §102(a) as being anticipated by Ashizawa be withdrawn.

In view of the foregoing amendments and discussion,
the application is believed to be in allowable form.
Accordingly, favorable reconsideration and allowance of the
claims are most respectfully requested.

Respectfully submitted,

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JANUARY 7, 2003

Date



"VERSION WITH MARKINGS TO SHOW CHANGES MADE"

IN THE SPECIFICATION:

Paragraph beginning at line 19 of page 8 has been amended as follows:

In Fig. 3, the piezoelectric element 2 has, on one surface, four electrodes 3b, 3c, 3d, 3e in areas separated or divided in a grating form by connecting between center points of the mutually-parallel sides of the vibrating body 1. Although not shown, the piezoelectric element 2 has an electrode 3a extending over the entire of the other surface thereof, and in the entire portion is polarization-treated in the same direction as a thickness direction. In the figure, + refers to a polarization direction. Herein, a drive electrode is applied between electrode 3a and the electrode 3b, 3e, a standing wave is caused having a node on the diagonal line 10b of Fig. 2. Next, if a drive signal is applied between the electrode 3a and the electrode 3c, 3d, a standing wave is caused having a node on a diagonal line 10a of Fig. 2.

Paragraph beginning at line 8 of page 9 has been amended as follows:

Next, another example of an electrode structure on the piezoelectric element 2 is shown in Fig. 4. In Fig. 4, the piezoelectric element has, on one surface, four electrode parts 3f, 3g, 3h, 3i in the areas of the vibrating body 1

separated or divided in triangular forms by two diagonal lines, and polarization-treated in the same direction as the thickness direction in the entire portion. The piezoelectric element 2 has an electrode 3a provided over the entire surface thereof. By applying a drive signal to adjacent two electrode of the four electrodes 3f, 3g, 3h, 3i, a vibration wave is caused on the vibrating body 1.

IN THE CLAIMS:

Claims 14 and 15-17 have been amended as follows:

14. (Thrice Amended) An ultrasonic motor comprising: a vibrating body; [and] a piezoelectric element having a plurality of areas and formed on the vibrating body; and a plurality of electrodes each formed on a respective one of the areas of the piezoelectric element; wherein the areas of [for vibrating the vibrating body,] the piezoelectric element on which the electrodes are formed are [having a plurality of divided areas] polarized in the same direction after the piezoelectric element is formed on the vibrating body.

15. (Thrice Amended) An ultrasonic motor comprising: a generally plate-shaped vibrating body; and a piezoelectric element bonded on the vibrating body and having four areas [divided] separated by two diagonal lines of the vibrating body and a plurality of polarized portions polarized

in the same direction, each area having an electrode portion corresponding to a respective one of the polarized portions; wherein the vibrating body is vibrated by applying drive signals different in phase by 180 degrees to two of the electrode portions.

16. (Thrice Amended) An ultrasonic motor comprising: a generally plate-shaped body; and a piezoelectric element bonded on the vibrating body and having four areas [divided] separated by two lines connecting a center of a first side of the vibrating body and a center of a second side of the vibrating body opposite to the first side, each area having an electrode portion; wherein the piezoelectric element has a plurality of polarized portions polarized in the same direction and each corresponding to a respective one of the electrode portions; and wherein the vibrating body is vibrated by applying drive signals different in phase by 180 degrees to two of the electrode portions.

17. (Twice Amended) An ultrasonic motor comprising: a vibrating body having a piezoelectric element for vibrating the vibrating body; a moving body rotationally driven by a vibration of the vibrating body; a pressurizing member for pressing the moving body into pressure contact with the vibrating body; and a bearing portion disposed on the pressurizing member for guiding rotational movement of the

moving body; wherein rotational movement of the moving body is
[regulated] restricted by the pressurizing member and the
bearing portion.